PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to a Process and Apparatus for Coating Articles

We, COMPAGNIE DE SAINT-GOBAIN, a Body Corporate organised under the laws of the French Republic, of 62, Boulevard Victor-Hugo, Neuilly-sur-Seine (Seine), France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which is to be to performed, to be particularly described in and by the following statement:—

The present invention relates to a process and apparatus for coating articles and more particularly, but not exclusively, for coating glass bottles.

Processes are known for coating glass bottles with a layer of a plastics material, for example, polyvinyl chloride. This layer affords protection to the bottle against shock and also to a person handling such a bottle, when it contains a liquid or a gas under pressure, because in the event of the bottle being broken, the fragments of glass are retained by the plastics envelope. In these known processes, the glass bottles are first heated to a relatively low temperature, generally to a temperature of 80—100° C. They are then immersed in a bath of liquid plastics material for the period of time required for the plastics material to extract the heat stored in the glass. On leaving the bath the bottles are drained of the surplus plastics material and in some processes they are subjected to the action of an electrostatic field for this purpose. The bottles are then baked in an oven at a temperature of the order of 180—200° C. for a relatively long time, of the order of about 10 minutes, removed from the oven and finally cooled.

Usually the bottle is immersed in the liquid bath with its axis inclined to the surface thereof to permit air bubbles trapped under the base of the bottle to escape. While the bottle is immersed in the liquid it is displaced laterally of the bath, which must therefore have a fairly considerable volume.

According to the present invention a process for coating an article by preheating the uncoated article and immersing it in a bath of a liquid which sets or solidifies at a temperature higher than that of the bath, is characterised in that the temperature to which the article is preheated is such that on leaving the bath, after having been immersed for a time sufficient to provide the desired thickness of coating, the article is still at a temperature higher than the setting temperature and at least sufficient to cause the outer surface of the coating to set or solidify.

When the coating material is, for example, a paste comprising polyvinyl chloride and one or more plasticisers, the article is preheated to a temperature higher than 100° C., and preferably between 130° and 180° C, and the coated article is baked at temperatures of the order of 350—400° C.

In the present process an article to be coated is disposed in a heating zone for a prolonged period which ensures that the material of which the article is formed, generally glass, has a large heat reserve. This heat reserve is greater than that necessary for setting or solidifying the desired thickness of the plastics material so that the temperature of the article when it is withdrawn from the liquid bath is greater than the setting temperature. It therefore makes it possible:

1). To reduce the period of immersion of the article in the liquid bath, to control the thickness of the coating by limiting the period of immersion and not, as in known processes, by the heat reserve stored in the article.

2). To ensure coagulation of the still fluid external layer of the coating when the article leaves the bath, whereby draining of the article of surplus coating material, by

electrostatic means or otherwise, and coagulation of the external layer by use of infra-red rays, as employed in some processes, are avoided.

3). To avoid the thickness of the material of the article influencing the thickness of the coating. The heat reserve of the article varies with the thickness of the material from which it is formed. Consequently, in processes utilising low pre-heat temperatures, and which depend upon the extraction of heat from the article immersed in the liquid bath to produce the desired coating, the thickness of the latter varies with the thickness of the material. In the process according to the invention, since the heat reserve is high, the thickness of the deposited coating depends upon the duration of the immersion of the article in the bath. The present process enables a coating of much more uniform thickness to be obtained on the article and, in particular, to ensure that the corners thereof are better covered. It is found, for example, that the thickness of the coating on a corner of an article is about 25% less than that on the remaining surfaces instead of 50—60% as in the known processes.

4). To bake the article rapidly because the material of the article is still hot. In addition, since plastics material can withstand a very high thermal shock provided that it is of short duration, and since the baking period is reduced, it is possible to raise the temperature of the baking stage above that normally employed. Thus, the baking stage, when the coating material is, for example, polyvinyl chloride, may be carried out in 1 minute 50 seconds at temperatures of 380—400° C., instead of 10 minutes at 200° C. as in the known processes.

In addition to the time saved rapid baking generally ensures greater clarity of the coating.

Rapid baking also permits flaws in the articles that have occurred in this stage of the process to be rapidly detected and corrected while the process is progressing, that is to say, a defect in the baking stage can be detected before many defective articles have been produced.

A uniform heat distribution in the article produced during the pre-heating stage ensures a good distribution of the deposited coating over the surface of the article.

However, it is possible by producing an appropriate temperature gradient in the preheating furnace to vary the thickness of the coating deposited from the top of the article to the bottom. More especially in the case of a bottle, it is necessary for the neck to be hotter than the base, in order to compensate for the difference in the time of immersion of those parts of the bottle in the bath. The temperature gradient may be produced by controlling the turbulence of the convection currents in the furnace. If this turbulence is very weak, the temperature at the top of the furnace is higher than the temperature at the bottom. The weaker the turbulence, the greater is the temperature difference between the top and bottom of the furnace.

In the process according to the invention, the immersion of the article in the bath can take place with a minimum displacement of the article in relation to the bath.

The article is preferably introduced into the bath in a vertical direction, and in the case of a bottle, with its axis inclined to the free surface of the liquid in order to avoid trapping an air bubble in the cavity in the base of the bottle. The bottle is subsequently orientated, preferably about a horizontal axis extending as close as possible to the centre of gravity of the immersed volume, to bring the axis of the bottle back to the vertical. This orientation of the bottle is necessary to bring the flange on the neck of the bottle parallel to the free surface of the liquid at the maximum depth of immersion. Finally, the bottle is vertically withdrawn from the bath.

The advantage of minimum displacement of the bottle in relation to the bath is that it ensures that the plastics material is distributed as uniformly as possible over all the surfaces of the bottle. In the known processes, the translational movement of the bottle in the bath creates unsymmetrical convection currents which result in an unequal distribution of the coating.

Moreover, by immersing the bottle in accordance with the present process it becomes unnecessary for the bottle to be rotated in the bath as in some known processes for improving the distribution of the plastics coating. This permits of simplifying the apparatus required to carry out the process and of greater precision in the depth of immersion of the article.

The present process also permits a tank of very small dimensions to be used to hold the liquid, so that the quantity of liquid lost is small.

Withdrawing the bottle vertically from the bath ensures that the residual drop of liquid is positioned at the centre of its base, that is, in a region in which it will not detrimentally affect the stability of the bottle when resting on its base. It is therefore unnecessary to provide means for removing the drop of liquid.

If desired, the bath of liquid can be electrically insulated from earth and electrically charged, whereby a better flow of liquid along the bottle as the latter is withdrawn from the bath is attained, so that the thickness of the entrained liquid film is reduced,

thus improving the setting of the outermost layers of the coating. In addition, the liquid carried out of the bath on withdrawal of the article is reduced.

It has been found that it is desirable to vary the speed of withdrawal in a vertical direction of the article from the bath to provide a substantially constant flow along the profile of the article. For this purpose the speed may be varied in accordance with the relation

$$V=K \sin^2 \alpha$$

in which V is the speed of withdrawal,

K is a constant dependent upon the viscosity of the liquid coating material,

α the angle made with the horizontal by the tangent to the surface of the article at any point of the said surface which is at the level of the surface of the liquid.

If the article is a bottle it is advantageous, at the end of the immersion stage, to impart a relative vertical reciprocatory motion of small amplitude (for example from 2 to 4 millimetres), between the bottle and the free surface of the liquid, which ensures that an additional thickness of the coating is built up around that part of the flange of the bottle neck on which a cap is to be crimped.

An embodiment of the process and apparatus according to the invention will now be described by way of example, reference being made to the accompanying drawings in which:—

Figure 1 is a diagrammatic view of the apparatus according to the invention with parts shown in section,

Figure 2 is an end elevational view of a part of the apparatus of Fig. 1 drawn to a larger scale and partly in section and,

Figure 3 is a diagrammatic view of another part of the apparatus of Fig. 1 drawn to a larger scale.

Each bottle 1 to be coated is mounted on a rod 2 and a number of these rods 2 are fixed on each of a number of bars 3 of square cross-section. Each bar 3 is articulated at its ends to the respective one of a pair of endless chains 4. A guide device (not shown) holds the bars 3 fast on the chains 4 in a position such that the rods 2 extend normally away from the plane of the chains and on one side thereof.

To secure each bottle 1 to its associated rod 2 there are provided two L-shaped levers pivotally connected by a pin 7 to the rod 2. One arm 8 of the levers extends in a direction substantially parallel with the bar 3 while the other arm 9 extends in a direction substantially normal to the bar 3 and has a boss 10. A ring 11 is fitted around the rod 2 and is held by a spring 5 against the arms 8 of the levers so that the bosses 10 tend to move apart. To attach a bottle 1 to a rod 2 the neck of the bottle 1 is engaged about the bosses 10 and pressure applied to the bottle 1 so that the bosses 10 move towards each other and are able to enter the neck. The bosses 10 move apart again and secure the bottle under the action of the spring 5. The bottle is released with the aid of members 12 carried by a beam 13 adapted to be moved up and down. When the beam 13 is lowered, the members 12 bear against the arms 8 of the levers causing them to turn about the pin 7 thereby moving the bosses 10 towards each other so that the neck of the bottle 1 can be disengaged therefrom.

The chains 4 are caused to travel intermittently. The bottles 1 positioned at A (Fig. 1) are first conveyed into a pre-heating furnace 14, which is heated by burners 15, and after remaining therein for a period of time sufficient to allow them to attain a selected temperature they are conveyed to a location above the liquid bath. The intermittent travel of the chains 4 is so timed that they remain at rest with bottles 1 at this location until the next stage in the process is completed. At this location the square bar 3 has become disengaged from its guide means (not shown) and can consequently turn about its longitudinal axis. The bar 3 rests on an upper edge 16 of a plate 17 formed with a longitudinally extending slot 18, in which a journal 19 secured to a tank 20 engages. The plate 17 is pivoted about an axis remote from the journal 19. The tank 20 contains the liquid which sets at a temperature higher than that of the bath but lower than that to which the bottles 1 are pre-heated, and which is to be used to coat the bottles. The tank 20 is provided with a pipe 21 through which the liquid can be supplied from a source (not shown), and with an overflow 22 through which any surplus liquid can be returned to the source.

By means of a cam system not shown, the tank 20 is first caused to move a small distance in the direction of the arrow D (Fig. 3). The journal 19 displaces the lower end of the plate 17 which, in turning orientates the bar 3 about its longitudinal axis thereby inclining the axis of the bottle 1 to the horizontal. The tank 20 is then caused to rise in the direction of the arrow F bringing the liquid in the tank 20 into contact with the bottle 1 which commences receiving the coating. Since the axis of the bottle is inclined to the horizontal, no bubbles of air can be trapped under the base thereof.

As the tank 20 continues to rise, it moves in the direction of the arrow E until the axis of the bottle 1 is again normal to the horizontal. Towards the end of the immersion stage of the process, a relative vertical reciprocatory movement of small amplitude is produced between the bottle 1 and the liquid. When the coating has attained the

desired thickness, the tank 20 descends in the direction of the arrow F^1 to its initial position.

The movements of the tank 20 are produced by a cam (not shown) of appropriate profile. As it is desirable that the speed with which the bottles 1 are withdrawn from the liquid should be proportional to the square of the sine of the angle which the tangent to the profile of the bottle 1, at the surface of the liquid, forms with the horizontal, the profile of the cam is designed accordingly. For bottles having a substantially cylindrical body portion, a constant speed of withdrawal is provided while this portion of the bottle is leaving the liquid, by making the appropriate part of uniform shape.

The tank 20 is electrically insulated from earth and is electrically charged.

The coated bottles 1 after their removal from the liquid are conveyed by the chains 4 into the baking oven 23 and after baking are removed from the latter and cooled by streams of air supplied through nozzles 24. On arriving at 3, the coated bottles 1 are removed from the rods 2 and replaced by uncoated bottles 1 and the process re-commenced.

WHAT WE CLAIM IS:—

1. A process for coating an article by preheating the uncoated article and immersing it in a bath of a liquid which sets or solidifies at a temperature higher than that of the bath, characterised in that the temperature to which the article is preheated is such that on leaving the bath, after having been immersed for a time sufficient to provide the desired thickness of coating, the article is still at a temperature higher than the setting temperature and at least sufficient to cause the outer surface of the coating to set or solidify.

2. A process according to claim 1, wherein the preheating temperautre is sufficiently high to allow the still hot coated article to be baked for a period of time insufficient to cause deterioration of the coating.

3. A process according to claim 1 or 2, wherein the article is immersed in and withdrawn from the liquid bath by relative movement between the bath and the article in the vertical direction.

4. A process according to claim 3, wherein the article is so orientated during its immersion as to enable any air trapped by the article as it entered the liquid to escape.

5. A process according to any one of the preceding claims, wherein the speed of withdrawal of the article is varied to provide a substantially constant flow along the profile of the article.

6. A process according to claim 5, wherein the speed of withdrawal of the article at any given time is defined by the equation:

$$V=K \sin^2 \alpha$$

where V is the speed of withdrawal of the article, K is a constant and α is the angle made with the horizontal by the tangent to the surface of the article at any point of the said surface which at the given time is at the level of the surface of the liquid.

7. A process according to any one of the preceding claims, wherein the liquid bath is electrically insulated from earth and electrically charged.

8. A process according to any one of the preceding claims, wherein the liquid bath is a paste comprising polyvinyl chloride and one or more plasticisers.

9. A process according to claim 8, wherein the article is pre-heated to a temperature in excess of 100° C.

10. A process according to claim 8 or 9, wherein the article is pre-heated to a temperature in the range of 130° C to 180° C.

11. A process according to claim 8, wherein the coated article is baked at a temperature in the range of 350° C to 400° C.

12. A process according to claim 11, wherein the coated article is baked for a period of time of 1 minute 50 seconds.

13. A process according to any one of the preceding claims applied to an article having a flanged orifice, wherein the article is immersed in the liquid bath with its orifice above the free surface of the liquid and a relative reciprocatory motion in a vertical direction is produced between the article and the liquid.

14. A process according to claim 13, wherein the reciprocatory motion has an amplitude of between 2 and 4 millimetres.

15. A process for coating an article substantially as herein described.

16. A process for coating an article substantially as herein described with reference to Figs. 1 to 3 of the accompanying drawings.

17. A process according to any one of the preceding claims, when carried out in apparatus comprising conveyor means adapted to have the article attached thereto and to successively and automatically move the article to a heating location to bring the article to the pre-heating temperature, a coating location at which is disposed the bath of liquid which sets or solidifies at a temperature higher than that of the bath and means for immersing the article in the bath and removing it from the bath after a period of time sufficient to provide the desired thickness of coating on the article.

18. A process according to claim 17, wherein the apparatus includes means for baking the coated article.

19. A process according to claim 18, wherein the conveyor means disposes the coated article within the baking means.

20. A process according to any one of claims 17 to 19, wherein the means for

immersing the article in the bath and for removing it from the bath comprises means for displacing the bath vertically.

21. A process according to any one of claims 17 to 20, wherein a connection is provided between the conveyor means and the liquid bath to orientate the article during its immersion in the liquid.

22. A process according to any one of claims 17 to 20, wherein the arrangement is such that the article is in an inclined position when it is being introduced into the bath and is brought into an upright position before being removed from the bath.

23. A process according to claim 22, wherein means are provided for raising the bath when the article is in the inclined position, so as to immerse the article in the bath, and for moving the bath transversely while the article is being brought into an upright position, and then for lowering the bath.

24. A process according to claim 23, wherein the article is a bottle and means are provided for imparting a relative reciprocatory movement between the bottle and the free surface of the liquid at the end of the immersion period to build up an additional thickness of coating at the top of the bottle.

25. A process according to any one of the preceding claims, wherein the article is pre-heated in a pre-heating furnace in which an appropriate temperature gradient is maintained to vary the thickness of the coating from the top to the bottom.

26. A process according to any one of claims 1 to 16, when carried out in apparatus substantially as herein described with reference to Figs. 1 to 3 of the accompanying drawings.

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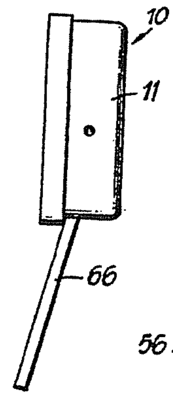


FIG.1a

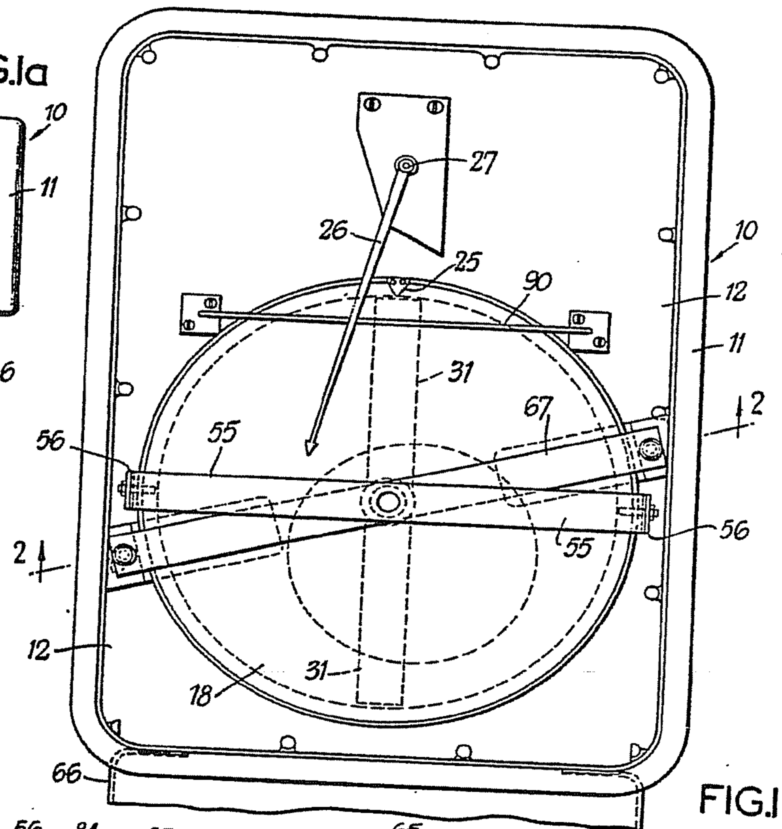


FIG.1

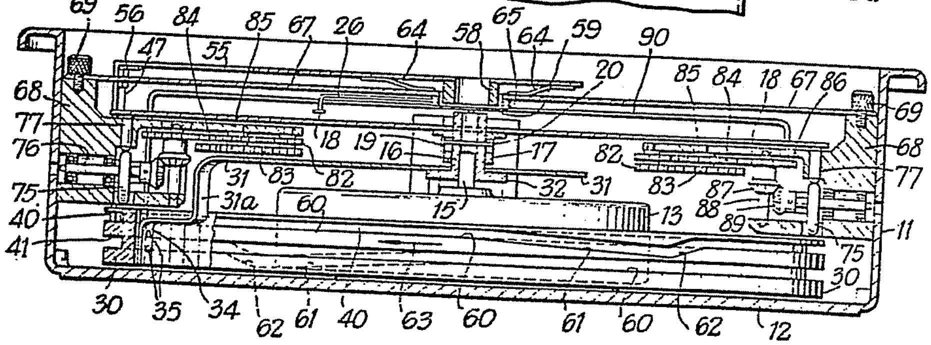


FIG.2

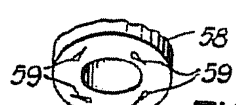


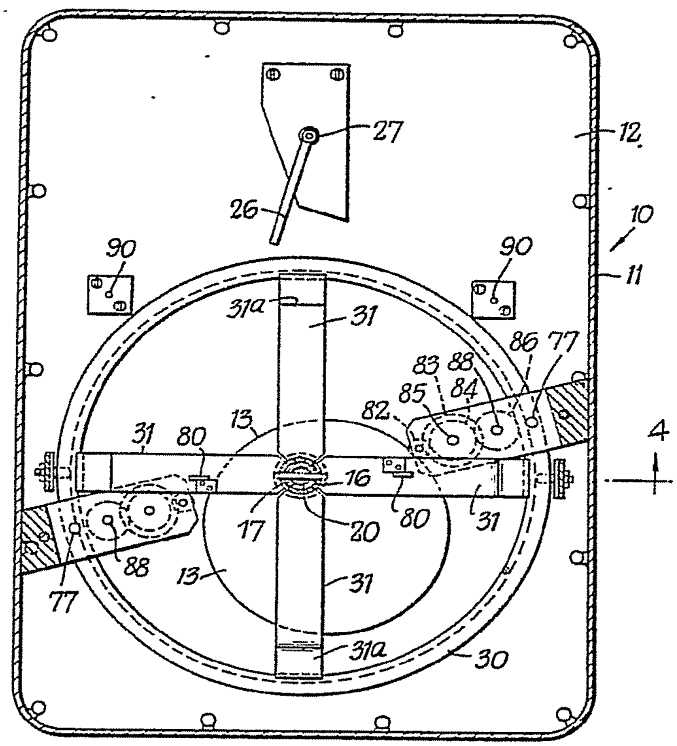
FIG.2a

936148 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheets 1 & 2

FIG.3



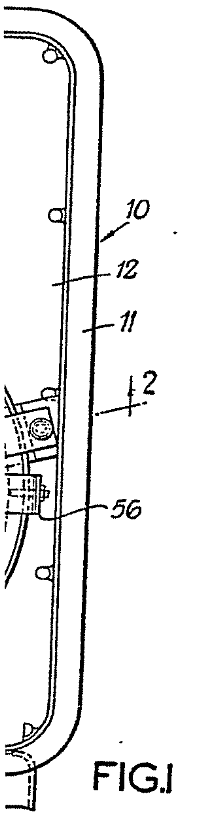
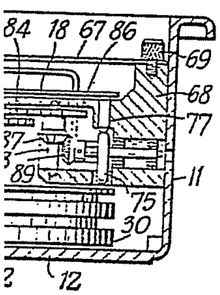


FIG.1



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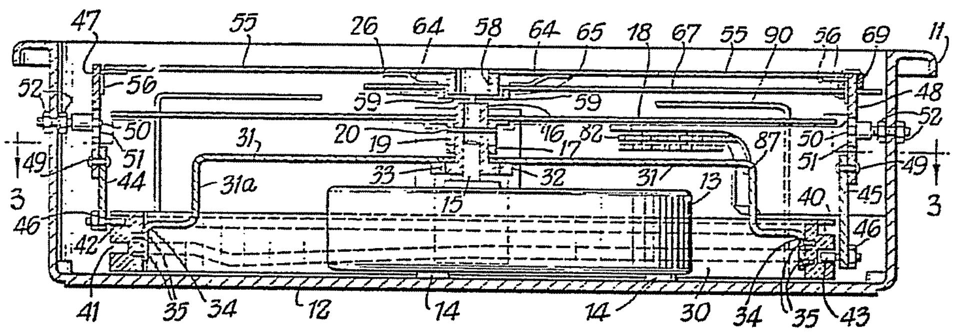

FIG.4

936147 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

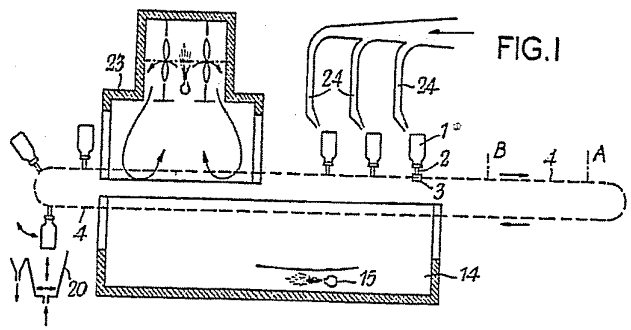

FIG.1

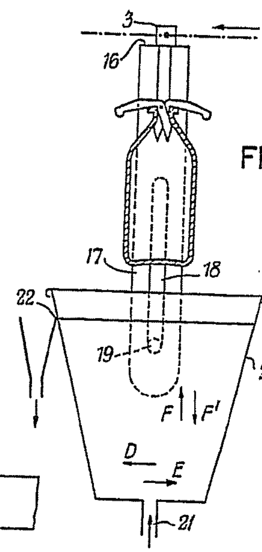

FIG.3

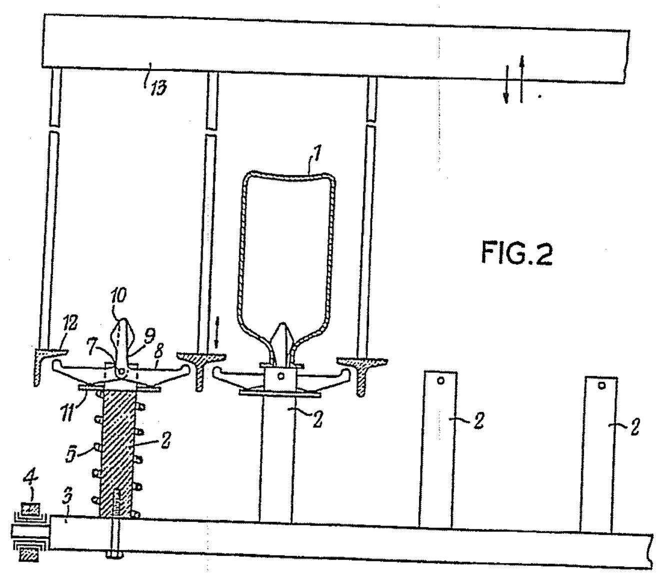

FIG.2